WASHINGTON STATE DEPARTMENT OF ECOLOGY

January 25, 2006

(Updated May 2006)

USE DESIGNATIONS FOR EROSION AND SEDIMENT CONTROL

For

Clear Creek Systems Inc. Chitosan-Enhanced Sand Filtration

Ecology's Decision:

Based on Ecology's review of Clear Creek Systems Inc. (CCSI) application submissions and the findings by the Technical Review Committee (TRC), Ecology is hereby issuing the following use designations for the Chitosan Enhanced Sand Filtration (CESF) technology for adequately controlling small particulate turbidity (clays, silt, etc.) in stormwater discharges at construction sites:

1. **General Use Level Designation for the CESF technology with the discharge of chitosan acetate treated water to retention systems capable of infiltrating all storms to the ground with no discharge to surface water. The design of the infiltration system must be based on the criteria in Volume V of Ecology's most recent Stormwater Manual for Western Washington. The design and operational criteria for the CESF specified in this document shall also be strictly adhered to. Records showing that total retention was achieved must be kept on site.**

2. **General Use Level Designation for the CESF technology with a discharge of chitosan acetate treated water from a temporary holding pond to surface water (batch treatment) only after the treated stormwater is demonstrated to contain less than 0.1 ppm residual chitosan acetate polymer or is non-toxic to aquatic organisms. The design and operational criteria specified in this document and in BMP C 250 of Ecology's Western Washington Stormwater Manual shall be strictly adhered to.**

3. **Conditional Short-Term Use Designation (CUD) for the CESF technology with the chitosan acetate treated discharges conveyed directly or indirectly to surface water (flow-through system). The chitosan dose rate shall not exceed 1 mg/L (as chitosan acetate by weight) or 100 mg/L as 1% FlocClear™ and not exceed 50**

mg/L as 2% FlocClear™. This CUD expires on January 31, 2007, unless extended by Ecology and takes effect when all the applicable "Conditions" and "Design and Operational Criteria" specified in this designation document are implemented or satisfied.

4. **Discharges from the CESF system under these designations:**

- **shall not cause or contribute to a violation of State Water Quality Standards,**
- **shall comply with the discharge requirements of the State of Washington Construction Stormwater General Permit, AKART, and local government requirements for turbidity and other applicable pollutants. This designation document must be used as the basis for Stormwater Pollution Prevention Plans for all construction projects where chitosan treatment is planned.**
- **shall be consistent with the guidance in BMP C250, Construction Stormwater Chemical Treatment, of Ecology's most recent Stormwater Management Manual for Western Washington.**
- **are expected to achieve performance goals of a minimum of 95% reduction of NTU turbidity, a maximum discharge of 10 NTU turbidity, and a discharge pH within a range of 6.5-8.5. If these values are exceeded at any time the responsible site operating personnel shall immediately take appropriate corrective actions.**

5. **All sites wishing to use chemical treatment must obtain approval for that use from the appropriate Ecology regional office.**
6. **Ecology hereby approves the CCSI Quality Assurance Project Plan, dated March 6, 2006.**
7. **Ecology hereby approves the Intended Use Plan dated May 3, 2006.**

<u>Conditions Applicable to Flow-Through CESF under this CUD</u>

1. **CCSI submitted an intended use plan that details how the FlocClear™ safety margin will be maintained during operation of their CESF system. The Intended Use Plan approval can be downloaded by clicking "Clear Creek System's FlocClear™ Intended Use Plan Approval."**
2. **The approved Quality Assurance Project Plan (QAPP) must be followed and includes:**

- **a field procedure for detecting a residual of chitosan in stormwater discharges greater than 0.1 ppm which has been accepted by Ecology. One can be downloaded by clicking "Colorimetric Determination of Residual Chitosan in Treated Stormwater."**

- **a selection process for pretreatments for influent turbidities above 600 NTU,**
- **a clear explanation (including appropriate graphics) of the relationship between pH and chitosan effectiveness for turbidity removal. It is desirable to illustrate the decrease in effectiveness when the pH approaches the optimum of 6.5-8.5.**
- **the sand filter operating indicator(s) for switching to the backwash cycle (pressure drop, effluent turbidity, etc.)**

3. During CESF operation, water quality influent and effluent shall be continuously monitored for pH and turbidity and the effluent shall be continuously monitored for chitosan concentration and/or aquatic toxicity.

4. During CESF operation, the following monitoring and operating procedures shall be strictly followed at all sites:

a. The metering pump must be calibrated at startup of the CESF and every four hours during the operation of the chitosan metering pump to ensure that the dosage is at or below 1.0 ppm at all times. All calibration results must be recorded simultaneously with the flow rates and the records kept on site.

b. The discharge from the sand filters must be maintained below 0.1 ppm residual chitosan acetate polymer at all times. At least two discrete grab samples of a homogeneous sand filter discharge must be collected during each operating period (CESF continuous operation up to 24 hours) and analyzed for residual chitosan polymer. The samples must be collected one and two hours after the onset of each operating period.

c. In the event that the chitosan residual in the discharge is greater than 0.1 ppm, or when the discharge exhibits aquatic toxicity, or when the CESF system is upset or fails, a contingency plan to immediately correct the problem must be included in the SWPPP. The contingency plan can include any of the following emergency operational measures, or equivalent measures for the handling of the "off-spec" stormwater:

- **temporary storage sized to handle all reasonable failure scenarios,**
- **discharge to a sanitary sewer if available and pre-approved by the sewer authority,**
- **discharge to an infiltration system with no discharge to surface water, or,**
- **truck hauling for proper disposal until the problem is corrected.**

d. At all construction sites, at the end of each 8-hour shift, a delegated responsible person must record his/her assessment of the operational efficiency of the CESF process, any upsets, the sand filter discharge chitosan concentrations (where applicable) and any other relevant observations that relate to CESF proper operation. They must also certify the acceptability of the CESF discharge to surface water.

e. Stormwater discharges from the CESF system shall not cause or contribute to receiving surface water quality violations. If the discharge from the CESF will be to a fish spawning area in the stream an additional approval for that discharge must be obtained from the responsible Ecology Regional Office. CCSI guarantees that CESF, when used as directed, will not produce treated water which exhibits aquatic toxicity caused by chitosan added as a treatment agent.

5. Source Control procedures will be implemented to the maximum extent feasible to minimize the need for chitosan treatment and for controlling the influent NTU to less than 600.

<u>Design and Operational Criteria Applicable to Conditional Use and General Use Designations</u>

1. The CUD and GULD apply only to Venture Chemicals, Inc. (VCI) FlocClear™ (1% and 2% chitosan acetate), Chemical Abstract Service number 64-19-7.

2. Because of the high solids loading in water associated with construction site runoff CESF systems must be designed and operated at a flow rate not to exceed 15 gpm per square foot of sand bed filtration area and should employ a minimum of three (3) sand filter pods to ensure adequate backwashing capacity. The backwash slurry from the sand filters must be discharged to a detention cell that is separate from the temporary storage cell for the incoming turbid stormwater. The overflow from the backwash slurry detention cell can overflow into the detention basin for the turbid stormwater.

3. The maximum suspended sediment (expressed as turbidity) of the influent water should not exceed 600 NTU.

4. The CESF system treated water output shall be equipped with automatic integrated turbidity and pH sensors capable of shutting the system down if output turbidity or pH exceed preset values. An audible alarm and warning light will be installed on the treatment system to alert the operator in the event of a system failure. CCSI is encouraged to include a computerized controller (like the Talus system) to automatically adjust chitosan dosage based on turbidity, flow, and pH.

5. Only filtration media approved in the Sand Filtration Treatment Facilities section (Volume V, Chapter 8) of the most recent Western Washington Stormwater Manual can be used in the filter system.

6. **Chitosan injection shall be performed with an LMI-brand C77, high viscosity pump head, electric metering pump, or equivalent. The CESF system shall include a flow-regulating valve on the input to and output from the sand filter. These regulating valves will reduce the maximum output of the pump as required and facilitate proper backwash.**

7. **The chitosan injection system (including metering pump, chitosan storage and instrumentation) shall be completely enclosed in a secure structure with locking door. The chitosan liquid concentrate tank, metering pump and tubing shall have secondary containment. The metering pump discharge tubing shall have an anti-siphon valve.**

8. **Jar tests will be conducted, as needed, to confirm the dosage level of FlocClear™.**

9. **During the planning (SWPPP preparation) of a project the potential impact on chitosan efficiency due to the use of anionic polymers that may be used for soil blanketing and stability, will be evaluated.**

10. **The CESF system shall only be operated by a trained technician certified through an approved training program including classroom and field instruction. During operation of the CESF, the trained technician must be present on-site. Training to be provided by Clear Creek Systems Inc. to include the following Minimum Training Requirements:**

Prerequisites:

- **Minimum 1-year experience with, and sound working knowledge of, high-pressure sand filter systems.**
- **Experience deploying and troubleshooting pressurized water pumping and piping systems.**
- **Fundamental knowledge of stormwater discharge regulations for applicable region/locale.**
- **Fundamental knowledge of stormwater quality testing procedures and methods for parameters applicable to the region/locale.**

Classroom – 4 hours

- **Stormwater regulatory framework and requirements**
- **Stormwater treatment chemistry (chitosan, pH, coagulation, filtration, etc.)**
- **Stormwater treatability (how to do jar testing)**
- **Treatment system components and their operation**
- **Treatment system operation**
- **Troubleshooting**

In the field – 40 hours

- **Operating the treatment system**
- **Entering data in the system operations log**
- **Testing turbidity and pH**
- **Optimizing chitosan dose rate**
- **Water quality sampling and testing (turbidity and pH)**

Applicant: Clear Creek Systems. Inc. (CCSI) Chitosan vendor and technical consultant

Joe Gannon, President

Applicant Address: 4101 Union Ave
Bakersfield, California 93305

Application Documents:

- Application for Conditional Short Term Use Designation for Chitosan Enhanced Sand Filtration, April 2005, Joe Gannon, Clear Creek Systems, Inc

The following are contained in the April 2005 application documentation:

- Flocculation Comparison Testing of Ven-Vis 204 and Storm Klear™ Liqui-Floc™, January 2005, Julie Morgan of Venture Chemicals, Inc.

- The Examination of Residual Chitosan Testing Procedures for Effectiveness, Reproducibility, and Reliability on Polymer from Various Manufacturers, Jason Martino and David Beard, Clear Creek Systems, Inc.

- Aquatic Toxicity Testing Results for a Product – Floc-Clear 2% A One-Species Chronic Definitive Bioassay, January 2005, Block Environmental Services

The following are contained in the October 2005 Application

- Clear Creek Systems, Inc. FlocClear™ Chitosan Enhanced Sand Filtration Stormwater Treatment Evaluation, October 2005, Water Tectonics

- FlocClear™ Chitosan Enhanced Sand Filtration Operations and Maintenance Manual, 2005, Clear Creek Systems

- Flocculation Comparison Testing of Ven-Vis 204 (FlocClear™) and StormKlear™ LiquiFloc™ Addendum to Original Application for Approval, Jason Martino, July 14, 2005

Applicant's Use Level Request:

Interim Short-Term Use Designation for the operation of flow-through Chitosan-Enhanced Sand Filtration (CESF) technology for the reduction of turbidity in

construction site stormwater. General Use Level Designation for the CESF technology with the discharge of chitosan acetate treated water to retention systems capable of infiltrating all storms to the ground with no discharge to surface water. General Use Level Designation for the CESF technology with a discharge of chitosan acetate treated water from a temporary holding pond to surface water only after the treated stormwater is demonstrated to contain less than 0.1 ppm residual chitosan acetate polymer or is non-toxic to aquatic organisms (batch treatment).

Applicant's Performance Claims:

For construction site stormwater runoff with a turbidity of less than 600 NTU (influent), a properly engineered and deployed *Chitosan-Enhanced Sand Filtration System* will remove greater than 95% of the turbidity, producing effluent that will consistently meet the State surface water discharge standards.

Chemical Technical Review Committee (CTRC) Recommendation:

The CTRC finds sufficient evidence to recommend to Ecology to grant Clear Creek Systems Inc. a CUD for a flow through CESF technology that can remove turbidity from stormwater at construction sites within acceptable limits.

Findings of Fact:

1. A CESF system has demonstrated the ability to reduce turbidity caused by the disturbance of sediment on construction sites by 99.1% (overall average) when operated at a flow rate of approximately 200 GPM to 97.2% when operating at a flowrate of 1200 GPM.

2. Influent turbidity levels above 600 NTU demonstrated the potential to cause a slow degradation of the turbidity removal performance by the system resulting in eventual system failure. CESF systems shall be limited to influent turbidity levels of 600 NTU or less**.** Turbidity levels above 600 NTU shall be allowed additional settlement time or be pretreated in another manner not covered in this application for Conditional Use Designation.

3. Water with a pH range outside the CESF treatment window of 6.5 to 8.5 shall be pretreated to achieve this range. This pretreatment process is not covered in this application for Conditional Use Designation.

4. In the CESF treatment systems that have been constructed and operated to date no aquatic toxicity has been observed in the treated filtrate.

5. The chitosan acetate polymer component, used for water treatment, is non-toxic to humans and other mammals, which makes it somewhat unique in the universe of

treatment agents. Chitosan acetate does, however, exhibit toxicity to rainbow trout and should therefore be used at a maximum dose rate of 1 mg/L as chitosan acetate as a conservative measure to ensure no possibility of toxicity to rainbow trout in receiving water.

6. CCSI provided a design/operation/maintenance manual, which includes information on selecting, sizing, assembling, operating and maintaining a CESF system.

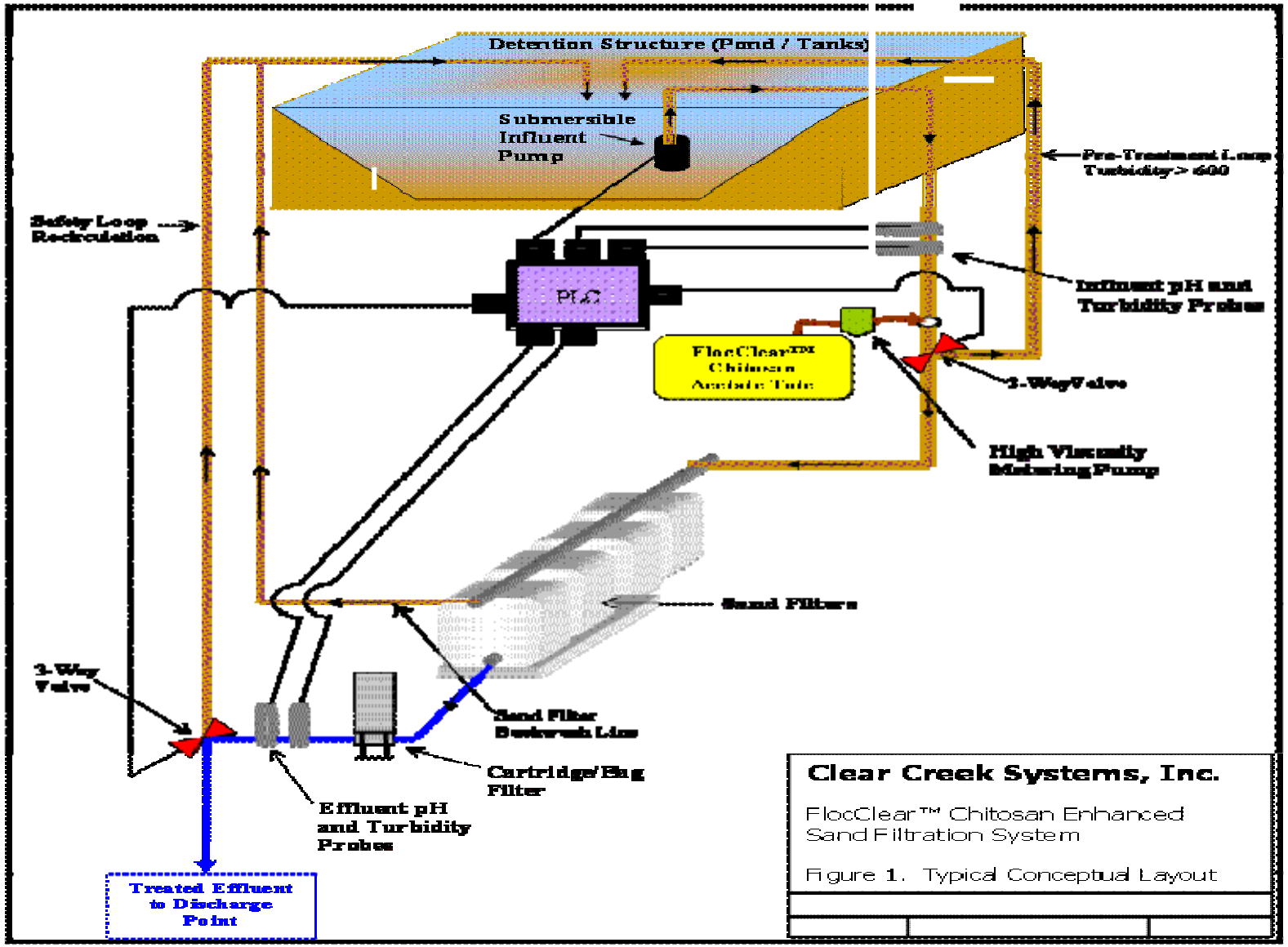
7. CCSI provided a significant amount of aquatic toxicity data demonstrating that the discharge residual of the chitosan acetate polymer is expected to be within toxicity levels acceptable to Ecology when used as directed.

Description of the Technology:

Chitosan-enhanced sand filtration (CESF) is a stand-alone construction site water treatment technology, which is comprised of four basic components:

- Stormwater transfer pump
- Chitosan addition
- Pressurized multi-pod sand filtration
- Interconnecting treatment system piping

CESF is a flow-through stormwater treatment technology (attached Figure) that utilizes chitosan, a natural biopolymer, in conjunction with pressurized sand filtration to remove turbidity (suspended sediment). Each treatment system is designed and installed to operated on an as need basis, pumping water from a retention basin whenever the water level of the retention basin is high enough to warrant processing. When stormwater is transferred from the retention basin to the sand filtration unit, chitosan is introduced to stormwater to coagulate suspended solids producing larger particles, which are retained within a sand filter. The filtration systems are equipped with automatic backwash systems, which will backwash the collected sediment from the individual filter pods as necessary to maintain the hydraulic capacity of the filtration media. This feature allows the treatment system to operate on a continuous flow-through basis.


Detention Structure (Pond / Tanks)
Submersible Influent Pump
Pre-Treatment Loop Turbidity > 600
Safety Loop Recirculation
PLC
Influent pH and Turbidity Probes
FlocClear™ Chitosan Acetate Tote
3-Way Valve
High Viscosity Metering Pump
Sand Filters
3-Way Valve
Sand Filter Backwash Line
Cartridge/Bag Filter
Effluent pH and Turbidity Probes
Treated Effluent to Discharge Point
Clear Creek Systems, Inc.
FlocClear™ Chitosan Enhanced Sand Filtration System
Figure 1. Typical Conceptual Layout

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